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NOISE IMPACT ANALYSIS
REGARDING
GLANBROOK LANDFILL PROJECT

BY

VALCOUSTICS CANADA LTD.
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TORONTO, ONTARIO

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NOISE IMPACT ANALYSIS

REGARDING

GLANBROOK LANDFILL PROJECT

1. INTRODUCTION

The purpose of this report is to present an analysis of the potential environmental noise impact of the proposed landfill operation. Of concern are the possible noise effects on a small number of residential properties in the vicinity of the site or on residential lands along the highway access route.

2. THE SITE

The western edge of the site commences some 1,800 feet east of Highway 56, with the boundary between the Regional Municipalities of Hamilton-Wentworth and Haldimand-Norfolk forming the southern limit. The existing Bell Road East and Regional Road No. 34 are the northern and eastern limits, respectively.

The site encompasses a total of 537 acres, of which only 250 would be involved in the landfill operation.

The general area is rural in nature with much agricultural land use as well as low density of residential development. The main road in the area is Highway 56. The village of Binbrook is located on this highway about 2½ miles to the north. About 9 miles to the northeast, is Hamilton Airport.

3. THE OPERATION AND POTENTIAL NOISE SOURCES

The operation will consist of the transport of compacted garbage from three transfer stations to the landfill site. This will be accomplished with a fleet of 18 "packer" vehicles each comprised of a tractor unit and a totally enclosed packer body. The body has a hydraulic ram to discharge the contents.

At the landfill site the packer trucks will empty their loads, which would be spread, levelled, and compacted in a defined area, by two bulldozers.

A third bulldozer will pull a "passive" scraper which will excavate material used to cover the levelled garbage.

In terms of noise generation, the operation may be segmented into four components:--

1. Packer vehicle movements along Highway 56 (as they may affect residential development along the highway).

2. Packer vehicle movements along the access road (as they may affect residential development along the road).

3. Packer vehicle unloading operations on site (relative to residential development bordering on the site).

4. Bulldozer spreading and excavation activities on site (relative to residential development bordering the site).

It is important to note that aside from the small number of vehicles related to the landfill site employees, the only vehicles accessing the site will be the packer trucks. The site will not be open to the public.

The landfill site will be in operation between 0800 and 2000 hours, 6 days of the week (excluding Sunday). During these hours, for purposes of this report, it may be assumed that two bulldozers would be involved in spreading and that one bulldozer and scraper would be doing excavation, with the possibility of a second bulldozer/scraper assisting when the demand required it.

The transfer station and transport schedule determine that the first packer vehicle would arrive at about 0815 hours, and that the last one would leave at 1930 hours.

Because there is no municipal garbage pickup on Saturdays, the Saturday traffic is estimated to be less than one-third of the weekday traffic to the landfill site.

4. ENVIRONMENTAL NOISE CRITERIA

The design criteria set forward by the Ministry of the Environment (1) are:--

Maximum L_{eq} (one hour)	Time Period
55	Day - 0700 to 1900 hours
45	Evening and Night - 1900 to 0700 hours

applicable at the nearest houses.

The parameter specified, L_{eq}, is the energy equivalent continuous sound level over the time period of interest. That is, L_{eq} represents the total sound energy dose. The specified time periods of interest in this case are hourly segments during operation of the noise sources.

5. NOISE IMPACT ANALYSIS AND ASSESSMENT

5.1 Introduction

The assessment of potential noise impact involves comparing the predicted sound exposure from the new operations against the pre-existing environmental situation, to determine the extent of change that may be expected with the new noise sources in operation.

5.2 Operational Parameters

Two fundamental possibilities exist with respect to transport volume requirements:--

a) with SWARU closed - 82 loads/day
b) with SWARU disposing of 120,000 tons/year- 63 loads/day

These possibilities result in 164 and 126 truck trips per day, along Highway 56 and the access road.

5.3 Highway 56

The section of Highway 56 subject to the greatest noise impact from movement of packer trucks would be that carrying the smallest volume of traffic now. This is the section between County Road 13 and the Haldimand-Norfolk townline. Table 1 summarizes the latest

available information (1976), published by the Ministry of Transportation and Communications(2).

Table 2 presents some hourly traffic count data obtained in June of 1978 (3). Using this data, the potential noise impact of the packer truck traffic may be assessed on an hourly basis. This is done by calculating the increase, to the hourly sound exposure (L_{eq}) resulting from existing traffic, that the additional traffic will cause.

For this analysis, the following assumptions were made:--

a) SWARU closed - 82 packer loads/day
b) the packer truck traffic is distributed uniformly over 10 hours of daily operation (16.4 trips/hour)
b) large trucks are the equivalent of 6 smaller vehicles in terms of noise generation

It is found that along the section of Highway 56 carrying the least existing traffic, the effect in 1978 would be to increase:--

- the AM peak hour L_{eq} by about 1.1 dB
- the PM peak hour L_{eq} by less than 1 dB
- the typical normal hour L_{eq} by about 1.1 dB

There are small and insignificant effects, for any hour. Along busier sections of this highway the relative effects

are even smaller. In addition, any growth in the pre-existing traffic volume, will reduce further the significance of any contribution of sound energy to the environment by the operation of the packer trucks.

Using the SADT and SAWDT figures of Table 2, an average weekend daily traffic volume can be computed. In each case, the volume is similar to that of the weekday situation. Therefore, the reduced packer truck traffic on Saturday will have negligible noise impact, even if it is assumed there are no trucks in the pre-existing traffic stream.

As a point of reference, Table 3 shows the L_{eq} noise exposure for the 1976 traffic volumes along Highway 56, for a distance of 100 feet from the edge of the closest lane. On a 24-hour basis, the criterion of $L_{eq}55$ is exceeded within a distance of 100-200 feet from the edge of pavement, depending on the section of roadway (i.e. traffic volume). For the peak hour, the distance must be increased to the range of 200 to 400 feet before the sound exposure is attenuated down to $L_{eq}55$.

The above analyses are based on what is known as the "Ontario Highway Noise Prediction Method" (4).

5.4 Access Road

The access road from Highway 56 to the site now exists as a gravel road to Trimble Road, reducing to a country lane in the region of the southwest corner of the landfill site, where it stops. East of Trimble Road, it services three residences. Extending east from about the southwest corner of the site is an unopened road allowance.

For purposes of this analysis, there is essentially zero traffic along what will be the access road. (The existence of this road allowance is independent of the landfill site. Were this road to be opened, the impact of the landfill site traffic would properly be determined in relation to the pre-existing traffic (which may or may not be significant). The future of the road allowance is not known. Therefore, its existence is ignored for the purpose of this analysis. The noise impact would then either be as predicted, or less.

The highway noise prediction techniques used above are not particularly appropriate in this case, because of essentially zero pre-existing traffic and the relatively small number of packer trips involved (compared to highway traffic volumes).

At distances greater than about 500 feet from Highway 56,

along the access road, the environmental sound exposure may be expected to be in the region of 40-45 dBA. This would be due to the combined effects of (relatively) distant traffic on Highway 56 and other roads, the sounds of nature (e.g. rustling of leaves, birds chirping, etc.), use of farm machinery, local activity, over-flying aircraft, etc.

The packer trucks may be considered as moving point sources of sound, when travelling along the access road. Therefore, the total noise exposure over any time period, at a given point, may be calculated for any number of "pass-by's", knowing the sound level characteristics of the sound source. Appendix A presents the method of calculation.

A standardized method of producing a sound level rating for a vehicle of the type in question is given in a standard of the SAE- Society of Automotive Engineers(5). However, this standard procedure determines the maximum sound level potential of the vehicle, as the test conditions involve rapid full throttle acceleration to maximum rated engine speed, and also deceleration from maximum rated engine speed.

The access road will be constructed to result in a level paved surface which will not require any significant vehicle acceleration. The operating speed is to be a maximum of 30 m.p.h. Further, it is anticipated that the

vehicle purchasing specifications will require a maximum sound level rating of 83 dBA (at 50 feet) as per SAE J366b. (Current production is to a rating of 86 dBA).

Some brief experiments with a 1976 packer truck (not built to a particular noise emission specification), indicate that under typical non-accelerating drive-by conditions, on a level surface, a peak pass-by sound level 10 dB lower than the SAE rating is a reasonable assumption. (As the vehicle approaches the observation point, the sound level will increase to a maximum at the point of closest approach, and then diminish again with increasing distance).

Table 4 presents an analysis of hourly L_{eq} for differing distances and numbers of pass-by's. The number of loads is equal to one-half of the number of pass-by's.

The existing houses on the access road route are estimated to range from 80 feet to 225 feet from the closest lane. Thus, it is seen that the anticipated number of truck pass-by's during the week (16-17 per hour), will comply with the recommended MOE design guidelines for hourly sound exposure. If the weekday operation is spread over a larger time period, say 12 hours, the typical hourly L_{eq} produced would be less, for the same total volume of activity.

The Saturday load volume, being significantly reduced

from that during the week, will also result in the MOE noise criterion being met along the route to the landfill site.

5.5 Site Operations

The noise impact analysis of the site operations is considerably more complex than the other aspects. This is due to the fact that relative to any particular residence of concern, the site activities may be more or less distant, depending on where on the site they are occurring, and more or less screened, depending on their location and any previous development on site.

The operational part of the site is one half or less of the total site area. At the south end, the closest that filling will occur is 600 ft. from the site boundary. For the eastern portion, the buffer distance is at least about 1700 ft. The buffer zone along the west boundary is 200 ft.; along the north boundary it varies between 200 and 400 ft. The operational boundary encompasses some 250 acres in an approximately square shape, 3100 ft. by 3400 ft. In the context of this section, the term "site" from here on refers to the portion used for landfill, and not to the total site.

There is a scattering of existing residences nearby. These are distributed as below:

No. of existing Residences	Distance to Operational Boundary
3	within 500 ft.
8	within 1000 ft.
10	within 1500 ft.

The working of the site will be according to an operational plan which divides the site into 16 cells, each approximately 600 - 900 ft. in length and width. Each cell would be excavated to 10 - 12 ft. below existing grade, and then filled to a final elevation of about 50 - 70 ft. above grade, depending on location. (The final contouring is detailed by others and reflects aesthetic and end use considerations.) Cells would effectively be worked in succession in a defined order. A prime reason for this technique is to permit control of surface water run off and other environmental factors. Each cell would have a lifetime of the order of 12 months.

Depending on which cell is in use, the actual distance from even the closest residence, to the noise sources (dozers or packer trucks) may be as much as 3500 to 4000 ft., or as little as 400 ft. in some cases.

The operation of each cell would involve excavation using a scraper pulled by a dozer, unloading of packer trucks, and spreading of garbage and cover material by two dozers.

Experiments with a 1976 packer vehicle at the Kingston facility of Tricil indicated that during the unloading operation, which lasts about 30 seconds, a steady sound level of about 70 - 72 dBA can be expected at 50 ft. from the tractor engine compartment.

Observations and measurements at the Baer Rd. landfill site (operated by Metropolitan Toronto) of the types of dozers contemplated for Glanbrook indicated sound levels in the range of 68 - 72 dBA at about 100 ft., when spreading fill. These were a D8K dozer by Caterpillar, and a 21C dozer by Fiat-Allis; both of which are recent designs incorporating silencing measures. (Information available at the time of preparation of this report indicates that these machines have a maximum sound rating of 88.5 dBA as per SAE - J88a (6)).

Using the following assumptions, the activity at each cell, excluding excavation, can be modelled as a point source of sound creating an hourly L_{eq} of 75.4 dBA at 100 ft:

1. Two dozers operating for 100% of the time producing 72 dBA at 100 ft.

2. Ten trucks unloading, each requiring 30 seconds and producing a sound level of 66 dBA at 100 ft. (72 dBA at 50 ft.).

3. An allowance of two minutes for each truck, for maneouvering, at a sound level of 69 dBA at 100 ft. (75 dBA at 50 ft.).

This is an overestimate because the dozers would not, in fact, produce the indicated level for 100% of each hour, and because the average number of trucks per hour is 6.3 or less, except on a worst case day, when they would average 8.2 loads per hour.

The distance from the source of sound to the listeners (nearest residences) will play an important role, since it may be assumed that there will be 6 dB of attenuation for every doubling of distance. Further, where distances exceed 300 or 400 ft., ground attenuation will increasingly contribute additional noise reduction. This ground attenuation is a function of elevation; diminishing with increasing height; and also a function of the type of terrain. The buffer zones will have either existing vegetation, including stands of trees, or landscaping to be provided so that in any event, acoustically, the ground is "soft" and capable of providing sound attenuation. In some directions where dense and tall vegetation intervenes, significant additional sound attenuation would result.

For the case of working below grade, the embankment will function as a sound barrier, which could provide as much as 5 to 10 dB of additional sound attenuation. In the

case of the filling operation, this barrier would grow progressively less effective as the working elevation increased. In the case of excavating, the reverse is true.

Table 5 summarizes the attenuation due to distance, based on a rate of 6 dB/distance doubled, and provides a conservative estimate of ground attenuation, relative to a reference distance of 100ft.

It is thus seen that in most cases, the total attenuation in the path between machinery and the nearest residences will be significant, and result in sufficient reduction such that the resultant sound exposure is deemed not to be a problem. The exceptions to this will be where the activity is sufficiently close to a neighbour for these effects not to come into play. This would occur for the most northerly cells, and the residences on Bell Road East, immediately opposite the site.

To minimize the impact on these (and other neighbours) the order of operation of the cells is configured to maximize the screening that one can provide relative to the others. That is, in general, the perimeter cells would rise to final elevation first, in order that they act as sound barriers for the inner ones.

The direction of excavating and filling each cell will also be chosen, where topographical conditions permit, so that

the rising berm of fill itself will screen as much of the machinery activity as possible.

Of course, any activity close to the north (or other) boundary of the site would be temporary in that the activity would move across the length of the cell, and eventually move to another cell. There will be cases where some residences would receive significant noise impact temporarily. The sound exposure values would not be unduly high, would occur only during "working hours", and would diminish as the construction proceeded, as outlined above. These "transient" events must be considered acceptable, as is any other temporary and necessary construction work.

6. CONCLUSION

It is concluded that based on site conditions and the noise control measures adopted, the noise impact of all of the operations associated with the Glanbrook Landfill Site will be negligible or within the limits considered acceptable by the Ministry of the Environment.

RESPECTFULLY SUBMITTED,
VALCOUSTICS CANADA LTD.

A.D. LIGHTSTONE, PH.D., P. ENG.

TABLE 1

GLANBROOK LANDFILL PROJECT

1976 TRAFFIC SUMMARY

HIGHWAY 56

	AADT (1)	SADT (2)	SAWDT (3)	WADT (4)
Jct. Highway 53				
	7,000	7,500	7,950	6,250
Jct. Reg. Road 22				
	5,250	6,450	5,950	4,300
Jct. Cty. Road 13				
	3,450	4,100	3,600	2,850
Hamilton-Wentworth/ Haldimand-Norfolk Line				

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1. AADT - Annual Average Daily Traffic
2. SADT - Summer Average Daily Traffic
3. SAWDT - Summer Average Weekday Traffic
4. WADT - Winter Average Daily Traffic

TABLE 2

GLANBROOK LANDFILL PROJECT

HIGHWAY 56, 1978 WEEKDAY TRAFFIC COUNTS

LOCATION	A.M. PEAK HOUR (0700-0800)	TYPICAL NORMAL HOUR (1400-1500)	P.M. PEAK HOUR (1645-1745)
Highway 53	508/21	348/51	727/26
Reg. Road 22 (Binbrook)	358/30	292/29	613/32
Hamilton-Wentworth/ Haldimand-Norfolk Line	221/16	189/24	328/27

Obtained June, 1978; no. of passenger vehicles/no. of trucks.

TABLE 3

GLANBROOK LANDFILL PROJECT

1976 HIGHWAY 56 SOUND EXPOSURE

	L_{EQ} BASED ON		L_{EQ} BASED ON AVG. PEAK HOUR
	AADT	SAWDT	
Jct. Hwy. 53			
	59	60	63
Jct. Reg. Road 22			
	58	58	62
Jct. Cty. Road 13			
	56	56	60
Haldimand-Norfolk Cty. Line			

Notes:

1. At a distance of 100 ft. from the edge of the closest lane. Reduce by 4.2 dB for each doubling of distance.

2. Trucks accounting for 10% of the volume.

3. Speed of 50 m.p.h.

TABLE 4

GLANBROOK LANDFILL PROJECT

ACCESS ROAD LEQ ANALYSIS

NO. OF PASS-BY'S/HOUR	ONE HOUR L_{EQ} (DBA)		
	50'	100'	200'
1	43	40	37
5	50	47	44
10	53	50	47
12	54	51	48
14	54	51	48
16	55	52	49
20	56	53	50

Based on peak pass-by sound level of 73 dBA at 50', and speed of 30 m.p.h; ignoring effect of pre-existing sound environment. Distance shown is from center line of closest lane.

TABLE 5

GLANBROOK LANDFILL PROJECT

SOUND ATTENUATION AS A FUNCTION OF DISTANCE

Distance	Geometric Attenuation (dB)	Ground Attenuation (dB)	Potential Total (dB)
100	0	0	0
200	6	0	6
400	12	3 - 4	15 - 16
800	18	5 - 8	23 - 26
1,000	20	8 - 10	28 - 30
1,200	22	10 - 12	32 - 34
1,500	24	12 - 15	36 - 39
2,000	26	15	41
3,000	30	15	45
4,000	32	15	47

APPENDIX A

GLANBROOK LANDFILL PROJECT

CALCULATION OF LEQ OF VEHICLE PASS-BY

Parameters:

1. x - distance from observer point to center line of vehicle path (ft. or m.)
2. s - vehicle speed (ft/sec or m/sec)
3. L_p - peak sound level at closest approach
4. n - number of pass-by's in time period T
5. T - time period of interest (seconds)

Sound Level at any Instant:

$$L_t = L_p - 10 \log\left(\frac{x^2 + s^2 . t^2}{x^2}\right)$$

where $t = 0$ is time of closest approach

L_{eq}:

Obtained by integrating the energy of each pass-by, multiplying by the total number, and averaging over the time period of interest.

Assumptions:

a) Vehicle is a point source (6 dB attenuation per doubling of distance;

b) No ground attenuation;

c) Sound build-up curve/decay curve is symmetrical about $t = 0$.

$$L_{eq} = 10 \log \frac{n}{T} \int 10^{\frac{L_p}{10}} \frac{x^2}{x^2 + s^2 \cdot t^2} \cdot dt$$

$$= 10 \log \frac{n\pi}{T} \cdot 10^{\frac{L_p}{10}} \cdot \frac{x}{s}$$

Example:

For one hour period during which 10 pass-by's occur, each producing 73 dBA peak level, at a distance of 50 feet, with vehicle speed of 30 m.p.h.

$n = 10$

$T = 3600$ (sec)

$L_p = 73$ dBA

$x = 50'$

$s = 44'/\text{sec}$

$L_{eq} = 53$ dBA

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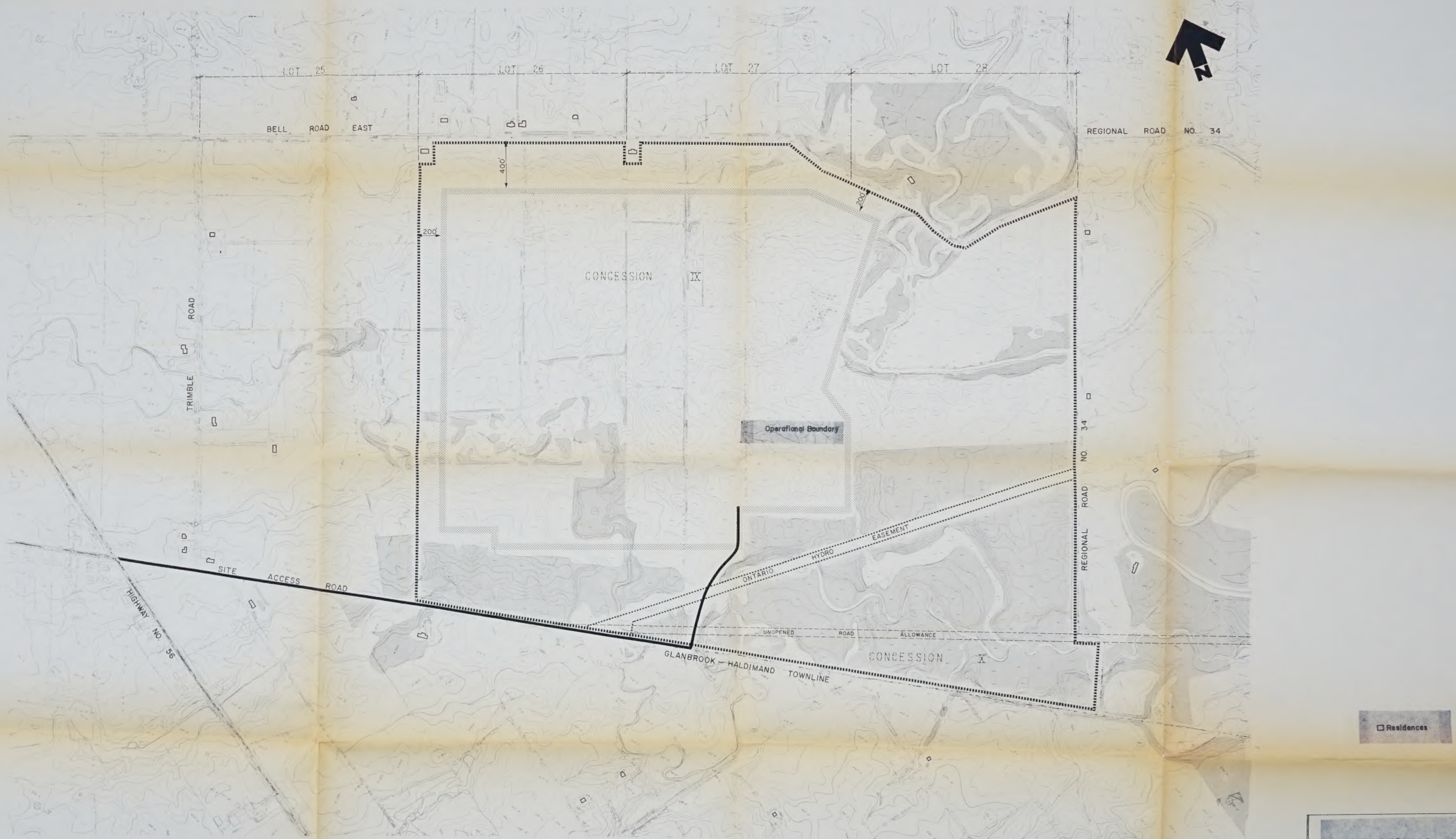

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